An Introduction to Wildlife Sound Recording

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WILDLIFE SOUND RECORDING SOCIETY

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Contents:

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Foreword
Wildlife sound recording is a specialised pursuit and few books have been written on the subject. It can, therefore, be difficult for a beginner to make sensible decisions about what recording equipment to use. This booklet has been produced to help 'get you started'. It does not encompass studio work (copying, mixing etc.) but concentrates on making field recordings. It will not answer all of your questions, but hopefully will lead you to sources that can.

The views expressed are those of the authors. We believe that the factual information given is correct. The examples of equipment in the booklet are of items commonly used by wildlife sound recordists. Mention of such equipment in the text does not imply that the Society or authors of the text endorse that equipment. Prices given are not necessarily exact, but are provided to give an idea of the comparative cost of items of equipment.

The authors hope that you will find this booklet useful. We accept that certain techniques or important pieces of information may have been omitted. The authors therefore welcome constructive criticism and offers of improvements to the booklet.

Alan Burbidge, Mike Iannantuoni and Phil Riddett, March 1997.
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1. Introduction

People take up wildlife sound recording for a number of reasons. Most members of the WSRS are amateurs; some are professional recordists, and a few are professional biologists who use their recordings for research. Among the amateur members some try to build up their own libraries of as many species as they can; some concentrate on groups of animals and some prefer to concentrate on habitat or atmospheric recordings. These recordings can and are put to many uses. For example, some are made available to researchers; others are used by the recordist to complement their wildlife video and slide-shows. Wildlife sound recording is probably the most difficult sort there is. However, you will find it challenging, occasionally frustrating, but ultimately very enjoyable.

Different types of recordings need different techniques. This booklet is not meant to give a complete description of every technique: it is intended to give answers to some of the more important points to help you start. There have been a number of books written either partly or wholly about wildlife sound recording which you will find listed in Appendix A. Unfortunately some of the more useful are out of print, but public libraries can usually find copies, or it might be possible to borrow them from other members of WSRS.

This booklet is divided into a number of sections covering different aspects of wildlife sound recording. It has been kept short intentionally, and it may raise as many questions in your mind as it answers. Members of WSRS are always willing to help new members, so you shouldn't feel any reluctance to contact established members of the Society for help and advice. Different people have different preferences about equipment and techniques, so it may be advisable to talk to two or three.

2. Equipment

Equipment varies greatly in price. Generally speaking the more you pay the better it is likely to be suited to the exacting demands of recording wildlife sounds in the field. Nevertheless Members do make excellent recordings with very modestly priced equipment. So how do you choose? First, talk to lots of people. Second, try to decide what type of recordings you want to make and then get more advice about how suitable particular equipment is for that. Third, you could do what one member did: not buy any - at least not until this member had spent some time in the field with other members and tried out their equipment. WSRS has a Spring meeting in a good spot for recording and this is an ideal time to meet other members and discuss equipment and techniques.

Types of recorders

Recorders come in two basic types: analogue and digital. They work in somewhat different ways. In analogue recording, electronic signals from the microphone are turned into changes in a magnetic field produced by the record head of the machine. This magnetizes the tape. When the tape is played back the minute changes in the magnetized tape generate voltages in the playback head which are then amplified to reproduce the sound. The recording is an analogue of the original signal, and as the dictionary tells us, an analogue is something which is similar to the original. There are three main problems. The tape generates hiss, it doesn't respond exactly linearly to the signal, and it has a range of sensitivity which is limited. These problems are greater the narrower the tape is and the slower it passes the replay head, so they are more apparent on cassette than open spool. Not only that, but if a recording is copied the faults add up and you get what is known as generational loss.

For most domestic use one way round some of the problem of tape noise is to use a noise reduction system like Dolby. Unfortunately, these have been designed for music, and to a lesser extent, speech. Wildlife sounds have a nasty habit of showing up their

shortcomings. This is most often heard as a pulsing of the background sounds. So noise reduction systems are certainly not recommended for wildlife sound recording.

Digital recording is now well established. Compact Discs were the first practical format for domestic digital audio reproduction, and for portable digital recording Digital Audio Tape came in, then MiniDisc and computer disc & memory recording. All three formats have been widely adopted professionally. The way digital systems work is very different to analogue. Instead of a copy of the sound being made as a series of magnetic field changes, it is turned into a series of digital numbers which are then recorded as a series of pulses. There are several ways in which digital recording surpasses analogue. When the recording is played back the pulses are read from the tape and they are interpreted as having whole number values which can be checked and corrected before the sound's waveform is reconstructed. Within the sampling range of the system the response is linear. Not only that, but most digital systems can record a far higher dynamic range - the range from loud to soft sounds - than analogue. Because of the way that the digital signal is produced and read back there are virtually no speed variations - no wow or flutter - and no discernable distortion.

2.1. Field recorders

Recording wildlife sound is very much a minority sport, so you would not expect anyone to make the ideal recorder. Some things are necessary: the machine should be battery operated and light enough to carry for some distance; possibly over difficult terrain, it should be tough enough to stand up to field use and it should be clearly laid out and easy to use. You need to be able to control the recording level and hear what you are recording as you are doing it. Too much gain (recording level) will result in distorted (over-modulated) sounds. Being able to hear what you are recording helps minimise such faults. Very cheap recorders with automatic level controls are virtually useless for recording wildlife.

2.1.1. Analogue field recorders

There are two types, known as Cassette and Open Spool.

A: Cassette

You are probably more familiar with cassette than open spool. A lot of people have a mains cassette recorder, cassette/radio or a cassette player in the car. When this format was first introduced the quality was quite poor, but over the years both tapes and recorders have improved remarkably. Now, many members find it acceptable and use it successfully for wildlife sound recording. It has a number of advantages. The cassettes are cheap and easily available, they are light and record for a good duration. However, because the tape size is small (only about an eighth of an inch wide) and it runs at a comparatively low speed, the quality of the recording is still limited. Two types of cassette recorder are commonly used for wildlife sound recording, the Sony Walkman costing about £202 + VAT may still be available in some shops, and the Marantz CP430 at about £372 + VAT - prices taken from 2001, Canford Audio catalogue.

B: Open Spool

The oldest magnetic format still in use is quarter inch. It has been around for over fifty years, and until recently was the only format capable of giving professional quality recordings. The tape is wider than cassette, ¼" or 6.25mm, and it passes through the recorder much quicker than cassette tape, 7½ or 15 inches per second. The signal is spread over much more tape and is usually more faithful, so the quality is better than cassette, and can rival digital systems. These machines are bigger than most cassette recorders, they cost more, and there are fewer makes to choose from. Since the rise in use of digital field recorders the choice now is very much limited to second hand machines such as the Uher "Report Monitor" series, Nagra 4S and Stellavox. For both cassette and open spool machines it is an advantage to have three separate heads (erase, record and playback) on the recorder. This allows you to monitor

the signal while you are recording, but after the sounds have already been transferred to the tape.

2.1.2. Digital field recorders

There are a number of formats available at the moment: R-DAT or more simply DAT (rotary digital audio tape), MiniDisc, DCC (digital compact cassette) and various forms of computer disc or solid state (memory cards). They are all digital, but the first one (R-DAT) differs from the others in one important way. It is the only one of them not to use any type of data compression in order to get more recording time onto a limited recording medium. (This is sometimes an option on computer disc & memory card recorders but it severely limits recording time.) It has been found that the human ear can be fooled into not noticing if part of the sound is not recorded, provided the right part is taken away. Up to 80% of the sound can be discarded, and for most subjects very few people can tell that it's been done. However, the important word is people. The data compression system is designed for human hearing, not other animals. Many scientific researchers are reluctant to use these recordings because there is no way of knowing what has been omitted. What has been removed may not have been audible to us, but could have been vital for an animal.

A: DAT

This has been around since about 1988 and it uses a cassette tape designed specifically for these machines. The machines are about the same size range as analogue cassette machines so they are fairly light and easy to carry. Tapes run for up to 2 hours and are smaller than analogue cassettes. The quality can be superb, rivalling CD. Most machines record not just the sound, but also what is known as 'A' time, which tells you where you are on the cassette, allows for numbered index points to be inserted either while you're recording or afterwards, and some also record the time of day and the date when the recording was made. These machines do have a couple of disadvantages. The recorders use a rotary recording head and have

complicated circuitry, so power consumption is quite high. Also, because it takes time for the recorder to lace the tape, the machine can take a comparatively long time to be ready to record. Currently the only field R-DAT recorders still available are the Tascam DA-P1 at £921 + VAT, or less, and there may still be stocks of the Sony D8 at £499 incl VAT. You may find second hand Sony TCD10 Pro II, the smaller TCD7 or the HHB PDR1000. Not all digital recorders use DAT tape. Nagra make a digital one (Nagra-D) that uses a special ¼" tape. It has not proved widely popular in the Society, probably because of the price - £14,250 + VAT.

B: MiniDisc

Unlike any of the recorders that have already been described, MiniDisc does not use tape. It uses a disc a bit like a computer floppy disc, but recorded magneto-optically. With the reservation expressed above (compression), its quality is good and many recordists have taken to it. Because it is a disc based system it has one great advantage over the other formats - you edit the contents of the disc by simply telling the machine which bit to play next. Like DAT it uses index points, but because it can get from one to the next very quickly, and because it has a ten second, or more, store of sound read from the disc but not played out, you could play two recordings from either end of the disc without interruption. Again, like a computer floppy disc, you can discard sections that you do not want. If you have filled a disc, taken it home, listened to it, and decided that there are sections you do not want to keep, you can tell the disc that it can record over them. They are then put in the list of available space the disc keeps. It does not matter that you have discarded five recordings each five minutes long on different parts of the disc; as far as the system is concerned that twenty five minutes is available and you can make a continuous recording that long. Typical recorders are Sony MZ-R70 at £172 + VAT and Marantz PMD650 at £819 + VAT although models of the smaller machines change every year.

C: DCC

This system was launched a few years ago by Philips, but field recorders have only recently become available. Its great advantage is that ordinary analogue cassettes can also be played back on it. To record, a special DCC cassette is used. Like MiniDisc it uses data compression, but with that reservation the quality is quite good, certainly better than analogue cassette. The Philips DCC cost about £250 at launch but the format has not taken off.

D: Hard Disc & Memory Card

A number of manufacturers have produced recorders which do not use tape or disc but use computer solid state memory (PCMCIA Cards) or computer hard discs. Some use a system of data compression called MPEG or MP3 (MPEG-2, Layer-3) so may not be suitable for wildlife sound recording for the same reasons as MiniDisc. Machines are currently available from Denon, Marantz, Maycom Nagra and Sonifex, with others in the offing. Prices vary from £900 to several thousand pounds. Although recording time per memory card is reasonable when using compression, it is rather limited when recording linear digital audio as you would want to do for wildlife sound. As a rough guide, two channels (stereo) of 16-bit digital audio sampled at 48kHz will need about 11Mb of storage space per minute of recording time so you will get approximately 17 minutes on a 192Mb card.

2.2. Microphones

There are two types of microphone suitable for outdoor use; dynamic and condenser.

2.2.1. Dynamic microphones

These work by induction. Sound waves vibrate a diaphragm which is connected to a coil of wire around a magnet. This movement induces voltage changes in the wire which are fed to the recorder. This is the microphone's output and it is relatively small. The recorder's circuitry boosts it to a level suitable for the tape. Dynamic mics are fairly simple in principle, quite robust and, if properly designed, are faithful to the original sound. The low signal level can be a problem if the recorder's circuitry is not good, or if the signal is fed to the recorder via a long cable.

2.2.2. Condenser microphones

These work by having a diaphragm which forms part of a condenser so that, as the sound moves the diaphragm, it changes the capacitance of the condenser. This forms part of a circuit which produces a small electrical output which is amplified in the microphone. Condenser mics generally have higher output than dynamics. The diaphragm is not connected to a coil, so it responds well to high frequencies. The charge of the condenser can be affected by humidity, so condenser mics are more susceptible to damp conditions than dynamics. Condenser mics fall into two types:

A. True condensers

In these microphones the charge is generated by the microphone when it is powered. The powering also works the amplifier, and is usually either 12 or 48 volts, supplied by a separate power supply, a pre-amp or the recorder. They operate using specially modified electric circuitry which makes them more suitable for outdoor work. True condenser microphones are very good quality, have fairly high

outputs but are expensive. Sennheiser MKH range cost £838 for MKH20 - £1240 for MKH70.

Pearl also produce a range of condenser mics including mono mics and single point stereo mics all available as standard or high level output versions which may be more useful for wildlife sound recording.

B. Electret mics

These work on the same principle as true condensers, but the diaphragm is pre-charged and does not need an external voltage supply. All that then needs to be powered is the amplifier, which can be done by an internal battery. These mics are cheaper, but if the pre-charging leaks away, which it can do in time, the mic becomes less sensitive. Sennheiser electrets cost £110 for body & omni capsule - £225 for body & long gun capsule. Sony produce a wide range of electret mics including tie-clip and one-point stereo versions.

2.2.3. Preamplifiers

Many of the subjects recorded can be distant and, therefore, quiet. Simply increasing the record level will often solve this but nothing really replaces good field technique. However, even then you might find the signal could do with some help. Often portable recorders' mic inputs are not very high quality, so a pre-amplifier, usually called a pre-amp, can be used to boost the signal. There are commercially available pre-amps, but they can be costly. One or two WSRS members with the technical knowledge do make them and sell them to members and reasonable priced devices are available from FEL Communications.

2.2.4. Polar patterns and frequency response curves

There are two ways of showing how a microphone responds to sound. Polar patterns show how different microphones react to sound coming from different directions. Frequency response curves show how different microphones respond to different sound frequencies on axis.

A. Polar patterns

In an ideal world, you would point a microphone at a subject much as you would aim a camera. Unfortunately, sound does not behave like that. There is no microphone equivalent of a tele-photo lens which allows you to exclude some sounds completely. Having said that, microphones do respond differently to sounds from the side and behind, and an experienced recordist can use this to get better recordings. Microphones vary in their response from those that are equally sensitive to sound no matter what its direction, to those that are sensitive in a quite directional way. This is usually shown using a Polar diagram (Figure 1a-1e). In these diagrams it is assumed that the microphone is pointed towards the top of the page. The lines radiating from the centre of the diagram show the angle away from the front of the mic, and the sensitivity at each angle off-axis is plotted using a line which is furthest out for most sensitive, and nearest the centre for least sensitive. If you look at the diagram for the Cardioid mic you will see that it is most sensitive at the front, and that the sensitivity decreases as the angle approaches 180 degrees. It has to be stressed that this response is not equal at all frequencies. Generally, the lower the frequency of the sound the less directional the microphone. Normally, polar diagrams show a number of plots for different frequencies, usually with the high frequencies shown on one side of the diagram and low frequencies on the other.

So what use is all this? Often wildlife sounds are quiet, so they have to be amplified a lot. Under these circumstances the noise of the recorder or recordist can be noticeable. If you know where the

insensitive angles of the mic are you can position the mic so that the subject is on axis, but the source of noise is at an insensitive point.

Omni-directional response
Accepts sound equally from all directions.

Cardioid response
Accepts sound from in front of the microphone and the sides.

Super-cardioid response
Accepts sound mainly from the front of the microphone. Some sound is received from the sides but to a lesser extent than a cardioid microphone.

Figure-of -eight response
Accepts sound from the left and right of the microphone but is 'dead' to sounds from the front and rear.

Hyper-cardioid response
A very directional response. Accepts sound from a narrow angle in front of the microphone.

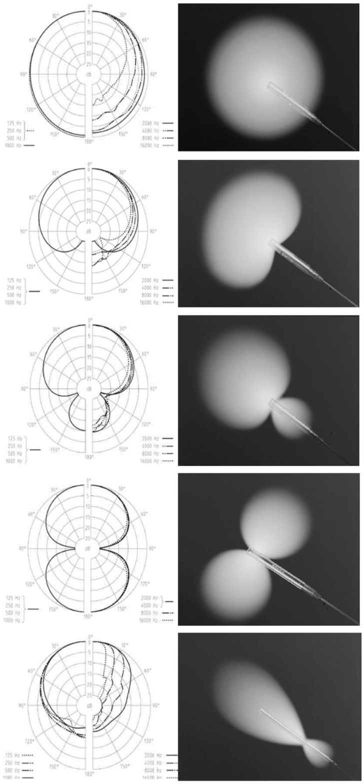

Figure 1: Polar Patterns.
The response of a particular microphone will vary over the frequency range tested. These polar patterns show the response of a range of microphone types at a range of frequencies. Bass

frequency responses are given on the left half of each graph, treble frequencies on the right.

The diagrams to the right of the graphs give a clearer visual impression of the response of each microphone.

These diagrams are reproduced with permission from Sennheiser UK Ltd.

B. Frequency response curves

An ideal microphone will respond equally to all frequencies (Figure 2). It then will not change the characteristics of the sound. Cheap microphones rarely achieve this, and the makers compromise and make the mics optimised for speech. Generally, the flatter the line the better, but when comparing diagrams it is important to check that the vertical axes use the same units. An upper frequency beyond 20,000 Hertz (Hz) is not very useful, as few recorders respond to such high frequencies. A very extended low frequency, below 40Hz, can give problems with wind, traffic and handling noise.

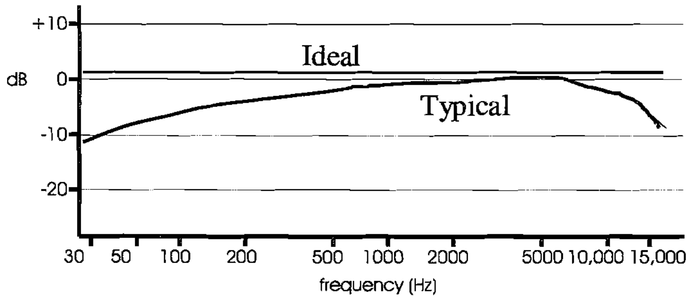

Figure 2: Stylised frequency response curve of a microphone suitable for wildlife sound recording. Ideally, the response curve should be parallel to the horizontal axis. Relatively cheap microphones are more responsive to the frequencies of human speech than other frequencies and so their response curves are not as flat.

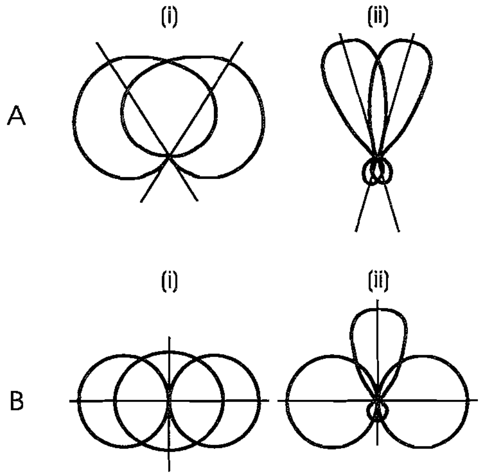

Figure 3: Stylised examples of the polar response patterns of microphones in stereo rigs. A. X and Y stereo (i) cardioid pair (ii) hyper-cardioid pair. B. M and S stereo (i) an omni and a figure-of-eight (ii) a hyper-cardioid and a figure-of-eight. In both A and B (i) gives a wider stereo picture than (ii). (see section 3.2)

2.2.5. Wind-shields and microphone cages

Wind is a problem. There is not much you can do about the sound that wind makes in trees, but wind on the mic is very distracting and can completely ruin a recording. Condenser mics are sometimes more sensitive than dynamics, but much depends on individual design. There are a number of solutions. The cheapest is the small foam rubber wind gags available from firms such as Tandy and Maplin. For small mics foam rubber toe protectors work, but for real wind protection a properly designed wind gag should be used. Some people make their own out of wire mesh (e.g. weldmesh - available from garden centres) bent to shape to produce the rigid framework for a windshield. Acoustic foam (see Appendix B) is the best wind-shielding material and can be glued to the inner and outer surfaces of the weldmesh frame. To protect the foam from

damage, the foam covered cage can be covered in a silk-like acoustically transparent material.

To reduce mechanical handling noise to a minimum, the microphones can be suspended using elastic. The elastic damps out mechanical noise. This elastic can be anchored directly onto the weldmesh frame, or a "cradle" can be incorporated into the design. Rubber bands are a very useful elastic material that can be used to suspend microphones. The "elasticity" of the bands can be reduced by twisting them. The number of twists that minimises mechanical handling noise needs to be determined empirically. Another solution is to buy a ready made windgag, such as the Rycote Softie, which can be used on all mics of about 20mm diameter, or one of their suspension mounted windshields, which come with a handle with tripod screw, elastic suspension mount and can be fitted with a hairy windjammer. Rycote are also prepared to produce 'one-offs' of designs sent to them. Windshields can also be supplied for parabolic reflectors (Section 3.1.2 and Appendix B). In all cases though, nothing is perfect, and even a quite innocuous breeze has been know to make recording impossible.

3. Recording in monaural and stereo in the field

3.1. Monaural recording

This is the simplest type of recording and is ideal if you want to build up a library of sounds of individual species. The majority of wildlife sound recordists seem to concentrate on bird song, so in the following text, for clarity, examples will refer to recording the Blackbird.

3.1.1. Close - up recording, open microphone technique

If you are interested in making recordings of individual species that are as faithful to the original sound as possible and lack significant extraneous noise, then you need to get very close to your subject. Obviously, the closer you get to your subject, the greater the signal to extraneous noise ratio. Such recording requires "fieldcraft"; you need to know your subject and position your microphone close to the Blackbird's songpost without causing any disturbance. Observation of your subject's activities over a period of time is necessary; positioning of the microphone may be best carried out under cover of darkness and in such a way that the microphone is not obtrusive. Usually, this type of recording requires the use of long microphone cables so that the recordist can observe the subject from a distance - or even the comfort of a car. One problem faced by such recordists is radio interference picked up by long cables. This problem can be overcome by using either 'balanced leads' or by using a powerful pre-amp near the microphone to boost the signal from the microphone, thus 'drowning out' the radio signal. Recordists who carry out this type of recording are likely to be those who need to be most careful on the issue of disturbance, especially at the nest (see section 6 Legal and Ethical Issues).

3.1.2. The parabolic reflector

The sounds produced by wildlife in general tend to have low level signals and are often uttered distant to the microphone. Therefore, any boost that can be given to the incoming signal is an advantage.

The simplest way to achieve this is to use a parabolic reflector. This is a dish, usually made of fibreglass or plastic with a diameter of about 50 to 60 centimetres. The cross-section of the dish is a parabolic curve so that all the signals incident on the dish and parallel to the axis are reflected to a focal point. It is at this focal point that the microphone is positioned, usually facing into the dish — the Telinga reflector/microphone setup is an exception to this. The choice of microphone and the use of reflectors have been the

subject of much debate in the past. Some recordists argue that the use of a reflector "colours" recordings because, especially when using an omni-directional microphone, sound waves reaching the microphone directly have shorter path lengths than waves reaching the microphone after reflection from the parabola. This can lead to sound waves of equal frequency cancelling each other out because of the difference in path length, i.e. if they are 'out of phase' with each other. One way of reducing this effect is to use a microphone with a cardioid response. Such microphones reject sound from the rear of the microphone and accept sounds from the side and front. If such a microphone is positioned facing into the parabolic reflector with its diaphragm at the focal point, only sound waves that have been reflected from the dish will be accepted by the microphone. The use of a parabolic reflector gives an increased gain and, therefore, allows the recordist to boost the incoming signal. The gain from a 20 inch diameter reflector at 1kHz is 12 - 15 dB and at 2kHz about 25 dB. One main advantage of the reflector is that it is directional. A Blackbird singing 20 yards away can be recorded well if the reflector is 'aimed' at the bird. However, if the reflector is moved even a few degrees 'off-axis' i.e. left, right, up or down of the bird, the signal will be reduced dramatically.

A further point about reflectors concerns the diameter of the dish. The lower the frequency of a sound the longer its wavelength. If the diameter of the dish is not large enough, bass frequencies will not be amplified as well as higher frequencies. This can make reflectors unsuitable for species such as deer or owls. Small reflectors can make recordings sound "tinny" because they lack bass. However, a reduced bass response can, in some circumstances, be seen as an advantage. With ever increasing levels of man-made noise, many recordists feel the need to use bass-cut filters, either as they record or when they copy their field recordings. Since the parabolic reflector preferentially rejects bass signals it can make a recording more aesthetically pleasing. Allied to this point is the directional property of the parabolic reflector, e.g. you can hear a distant road

to the North. If there is a Blackbird singing South of this road you can position your reflector between the bird and the road with the back of the reflector to the road. Such positioning can markedly reduce the extraneous noise recorded. Similar situations can arise with other sources of noise such as rivers. Careful positioning of the reflector can allow the recordist to reduce the strength of the river noise and increase the signal recorded from the subject. A final comment about reflectors: even very experienced wildlife sound recordists cannot tell if a recording was made with a reflector or by other means. The Amberwood 18" and 20" reflectors, made by WSRS members Barry Clamp & Roger Ireland can be obtained from them, the 20" version currently costing about £120 including a windshield. Telinga produce a parabolic reflector with an integral mono or stereo microphone at costs ranging from about £490 inc. VAT (for mono) to £1020 inc. VAT (for "DAT quality") stereo.

3.1.3. Gun and super-cardioid microphones

These are usually condenser microphones which accept sound from a very narrow forward angle. They are not as directional as reflectors but do not 'colour' recordings by preferentially amplifying higher frequency sounds. In contrast to reflectors gun mics reduce sounds from the side and rear rather than amplify sounds from the front.

3.2. Stereo and binaural recording

Recording in stereo is best suited to habitat or atmosphere recordings where individual animals each occupy unique positions in the 'sound stage'. There is little benefit to be obtained from recording individual animals in close-up in stereo, since ambient sounds will be at very low levels thus diluting the stereo effect. Three types of stereo microphone set-ups are commonly employed; each one is briefly described below.

3.2.1. Binaural recording

This technique developed from the image of the human head. In its simplest form, a 'dummy' head has a pair of identical (matched) microphones inserted where the two ears should be, so that the microphones point out from the dummy head, one to the left and one to the right. The recorded sound should give a stereo picture just as you would hear that picture with your own ears. Recordings made using this technique are best replayed through headphones. Some recordists say that listening in this way gives not only stereo, but also allows the listener to hear sounds that originated behind the dummy head. The microphone set-up need not be mounted inside a dummy head, other (windshielded) set- ups can be designed that are easier to construct.

3.2.2. Stereo X and Y format

Two matched microphones are crossed, one pointing to the left, the other to the right, to give a "V" shape. The capsules of condenser microphones or the diaphragms of dynamic microphones should be one above the other or as close as possible. If the microphones lie side by side with a gap in the middle, it is conceivable that sounds reaching the left microphone will be out of phase with those reaching the right microphone and hence will cancel each other out. Nevertheless, the separated microphone technique can give good stereo with pleasing effects.

The angle that separates the microphones depends on the choice of microphone. If a pair of gun (hyper-cardioid, directional) microphones are used, they accept sound from a narrow forward angle (see Section 2.2.4 - Polar Pattern and Response Curves & Figure 3). So, having a wide angle between these microphones means that no signals will be accepted from mid-way between the microphones. In other words, if a Blackbird is singing directly in front of the microphones, 20 yards away, it will give a weak signal on the recording because the microphones are not receiving the sounds. This is known as 'hole in the middle'. To solve the

problem the angle between the microphones needs to be reduced until the polar response patterns overlap. The optimal angle for hyper-cardioid microphones can be as little as 30° but is often determined by trial and error.

Recordings made using this sort of microphone will give a narrow stereo angle. If you want to produce a broader picture then you need to use microphones that are less directional. Using these types of microphone, the angle between the two microphones can be increased to about 60°. Examples of X and Y stereo rig response curves are given in Figure 3. One-point stereo mics are commercially available. The most common are electret condenser microphones which have two capsules, one pointing to the left and the other to the right. More expensive models allow you to alter the stereo angle to produce a wide or narrow stereo picture.

3.2.3. Stereo M + S format

This form of stereo pre-dates X + Y stereo and has recently become popular again. Mid and Side (M + S) stereo uses a different arrangement of microphones and offers a number of advantages over the X + Y format. A figure-of-eight microphone (receiving signals from the left and the right but not the centre) is placed below a forward receiving microphone which can be omni-directional, cardioid or hyper-cardioid (Figure 3). These arrangements result in a wide sound picture, an intermediate width sound picture and a narrow width sound picture respectively. By adding the signal from the forward receiving microphone to the signal from the figure-of-eight microphone, the left channel is produced [L=M+S]; the right channel is obtained by subtracting the signal from the figure-of-eight microphone from the signal from the forward pointing microphone [R=M-S)].

Usually, the signal from the forward receiving microphone is recorded directly onto one track of a stereo recorder and the figure-of-eight signal directly onto the other stereo track. To replay

or monitor the recording as stereo requires the use of a decoder which adds and subtracts the signals from the two tracks to give a left to right stereo picture. If a pre-amp is used, this conversion sometimes has to be performed before the signal reaches the pre-amp. As mentioned above, there are several advantages to M+S stereo.

(I) If the recordings are kept in coded form, then a mono recording can be obtained using the signal from the forward receiving microphone alone.

(ii) It is possible to apply equalisation to one signal. The figure-of-eight signal can have bass cut applied to it to reduce, for example, low frequency traffic noise without affecting the forward receiving signal. This can have the effect of reducing man-made noise to make the recorded sound aesthetically pleasing without over-filtering the total signal which could make the recording sound 'tinny'.

(iii) The arrangement of microphones used for M + S recording is much more compact than that for X + Y therefore making it easier to carry the rig in the field.

(iv) By varying the signal strengths from each microphone passing through the decoder, it is possible to vary the angle of the stereo sound picture, i.e. a narrow or wide stereo image.

Be aware though that if you record M+S, you will normally need to buy a headphone matrix to allow you to monitor in X+Y stereo and possibly a studio matrix to convert your M+S recording back to X+Y. One exception to this is the Pearl MS2 stereo mic which uses an M+S capsule arrangement but has a matrix built in and therefore outputs X+Y stereo to the recorder.

4. Identifying potential recording locations

This is perhaps the most difficult aspect of wildlife sound recording. If funds are available, excellent equipment can be obtained and the chosen mic rig designed and made. Finding suitable recording locations depends to a large extent on what you want to record.

First of all, select the habitat type that the species of interest inhabits. This can be done by drawing on your own knowledge or consulting such reference works as the Atlas of British Breeding Birds. Man-made noise can often ruin recording locations. For example, it is probably not worth while recording near a motorway if 'clean' recordings are what you are after. Checking a map and gaining local knowledge from site visits and talking to reserve wardens/landowners can be extremely beneficial. Of course, being an active member of your local County Trust or RSPB group will provide you with information and access to many reserves. Another way is to contact other WSRS members who have knowledge of the area in which you are interested. They may not be willing to give you extensive details of all the sites that they use, but they will probably give you some useful information.

You can improve your recordings by making use of the environment. Man-made noise, especially traffic noise, is generally at its least obtrusive during the hours spanning midnight to 6am. So, recordings made during this period tend to have lower levels of traffic noise. The local topography can also be used. If there is, for example, a hill between you and a main road, the hill will block out much of the traffic noise. Wind direction can also be important, either carrying traffic noise towards or away from you.

The Society trusts that all of its members will ensure that the necessary permission to enter private land is obtained from the owners/ guardians.

5. Field recording

This will obviously be the most time consuming, enjoyable (but sometimes frustrating) part of wildlife sound recording. All recordists have their own idiosyncrasies about field recording techniques. The best way to develop a technique is clearly to experiment, but also to solicit the views of other recordists. Attending field and local meetings is highly recommended. The following sub-sections outline generalised recording techniques.

5.1. Monaural field recording

Open microphone recording, where the microphone is close to the subject, relies more than any other recording method upon fieldcraft: knowing your subject. The microphone should be placed, probably under cover of darkness, or when the subject is known to be out of the vicinity, so that it is unobtrusive. Microphone cables should be hidden/camouflaged.

Reflectors are very commonly used to record individual animals, especially birds. Some recordists prefer to hand-hold their reflectors whilst others mount theirs on a tripod or monopod to minimise handling noise. Generally, the reflector is "aimed" at the subject and a recording made. To obtain a better signal-to-ambient noise ratio, move towards the subject and make a further recording. With experience, you will learn how near you can approach your subject without causing disturbance.

5.2. Stereo field recording (stereo open mic)

Techniques similar to monaural recording can be used. The sound picture can be recorded "opportunistically" or after observation of the habitat and informed positioning of the mics, either close to the recordist or on long leads. A reflector can be used to produce a stereo sound picture, however, it does produce a narrow sound picture.

6. Legal and ethical issues

In recent years the law governing disturbance to wildlife has become more restrictive. It is now necessary to obtain a licence to record a rare (Schedule 1, Appendix C) species at the nest or to wilfully disturb it. From letters and articles sent to the Society from official bodies such as the B.T.O. and English Nature, interpretation of the law is fluid. If you know that you want to record a particular Schedule 1 species at a particular location, the Society would advise you to apply for a licence or, at the very least, contact English Nature, Scottish Heritage or Countryside Council for Wales, to solicit their advice. All members of the Society are expected, as a condition of membership, to adhere to current legislation regarding wildlife.

The Society's Code of Conduct is reproduced in Appendix D.

7. Appendices

Appendix A - Bibliography.

*Fisher, John B. *Wildlife Sound Recording* (1977).
Pub: Pelham Books pp173. ISBN 0720710170.

Gibbons, DW, Reid, JB and Chapman, RA (1991)
The New Atlas of Breeding Birds in Britain & Ireland (1988-1991).
Pub. B.T.O./ T&AD Poyser ISBN 0 85661 075 5.

Hywel-Davies, Jeremy *The MacMillan Guide to Britain's Nature Reserves* (1989). Pub. MacMillan. ISBN 0-333-46790-6.

*Margoschis, Richard. *Recording Natural History Sounds* (1977).
Pub. Print and Press Services Ltd. pp 109 ISBN 0900602 24 4.

*Tombs, David *Sound Recording, From Microphone to Mastertape* (1980).
Pub. David and Charles pp 222 ISBN 0-7153-7954-2.

(*An asterisk by an entry indicates that the title is out of print)

Appendix B - Manufacturers' Addresses

AKG (UK Distibuter) (Andrew Landesberg)	Arbiter Pro Audio, Wilberforce Road, London, NW9 6AX Tel: 0208 2021199 Fax: 0208 2027076 Email: akg@arbitergroup.com www.arbitergroup.com
Amberwood	5 Richmond Close, Calmore, Southampton, Hampshire, SO40 2TH Tel: 023 8086 9486
Beyer Dynamic	17 Albert Drive, Burgess Hill, West Sussex, RH15 9TN Tel: 01444 258258 Fax: 01444 258444 Email: sales@beyerdynamic.co.uk www.beyerdynamic.co.uk
Canford Audio	Crowther Road, Washington Tyne & Wear, NE38 0BW Tel: 0191 418 1122 Fax: 0191 418 1001 www.canford.co.uk
Denon Pro-Audio	Chiltern Hill, Chalfont St. Peter, Bucks, SL9 9UG Tel: 01753 888447 Fax: 01753 880109
FEL Communications	31 Maryland Way, Sunbury-on-Thames, Middlesex, TW16 6HN Tel: 01932-786501 Email: fel@londonoffice.com www.felmicamps.co.uk

HHB Communications Ltd	
	73 - 75 Scrubs Lane, London, NW10 6QU Tel: 0208 962 5000 Fax: 0208 962 5050
Nagra - Kudelski	Nagra Kudelski (GB) Ltd 3U Long Spring, Porters Wood, St Albans, Hertfordshire, AL3 6EN Tel: 01727-810002 Fax: 01727-837677
Pearl Microphones	Systems Workshop The Old Smithy, Church Street, Oswestry, Shropshire, SY11 2SP Tel: 01691-658550 Fax: 01691-658549 Email: sales@systemsworkshop.com www.forgestudio.com
Rycote	Rycote Windshields Ltd, Unit 6, New Mills, Slad Road, Stroud, Glos., GL5 1RN
Sennheiser/Neumann	3 Century Point, Halifax Road, High Wycombe Buckinghamshire, HP12 3SL Tel: 01494 551551 Fax 01494 551550 Email:info@sennheiser.co.uk
Telinga	Auger Films Ltd, Telinga, Valley Farmhouse, Whitwell, Norwich, NR10 4SQ. Tel./Fax 01603 872498
Wilmslow Audio Ltd (Suppliers of acoustic foam)	Wellington Close, Parkgate Industrial Estate, Knutsford, Cheshire, WA16 8XL Tel: 01565 650605 Fax: 01565 650080

Appendix C - List of UK Schedule 1 Species

Avocet
Barn Owl
Bee-eater
Bearded Tit
Bewick Swan
Bittern
Black Redstart
Black-necked Grebe
Black-tailed Godwit
Black Tern
Black-throated Diver
Black-winged Stilt
Bluethroat
Brambling
Cetti's Warbler
Chough
Cirl Bunting
Common Scoter
Corncrake
Crested Tit
Crossbill
Dartford Warbler
Dotterel
Fieldfare
Firecrest
Gargany
Golden Eagle
Goldeneye
Golden Oriole
Goshawk
Great Northern Diver
Green Sandpiper
Greylag Goose
Gyr Falcon
Greenshank
Hen Harrier
Hobby
Honey Buzzard
Hoopoe
Kentish Plover
Kingfisher
Lapland Bunting
Leach's Petrel
Little Bittern
Little Gull
Little Ringed Plover
Little Tern
Long-tailed Duck
Marsh Harrier
Marsh Warbler
Mediterranean Gull
Merlin
Montagu's Harrier
Osprey
Peregrine
Pintail
Purple Heron
Purple Sandpiper
Quail
Red-backed Shrike
Red Kite
Red-necked Phalarope
Red-throated Diver
Redwing
Roseate Tern
Ruff
Savi's Warbler
Scarlet Rosefinch
Scaup
Serin
Shorelark
Slavonian Grebe
Snow Bunting
Snowy Owl
Spoonbill
Spotted Crake
Stone Curlew
Short-toed Treecreeper
Temminck's Stint
Velvet Scoter
Whimbrel
White-tailed Eagle
Whooper Swan
Woodlark
Wood Sandpiper
Wryneck

Appendix D - WSRS Code of Conduct

Members will at all times conduct their wildlife sound recordings activities so as to: do nothing to the detriment of wildlife or its environment, obey current legislation on such matters, respect the lawful rights of others and observe the Countryside Code.